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P-N Junctions Formed in Gallium Antimonide

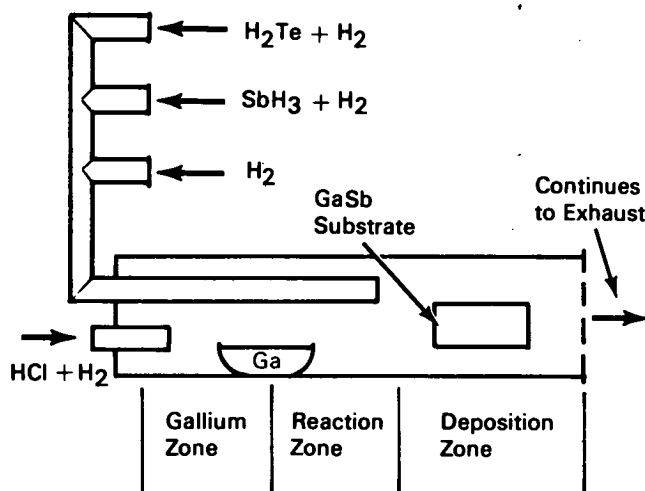


Figure 1. Vapor Deposition Apparatus

A recent prediction that a Gunn oscillator (source of microwave energy) prepared from gallium antimonide (GaSb) should have desirable properties of lower threshold field and higher efficiency than a device prepared from gallium arsenide, has generated considerable interest in developing new techniques for the preparation of p-n junctions in single crystal GaSb. Undoped GaSb is inherently p-type and would require a suitable n-type dopant, e.g., tellurium or selenium to form the n-region.

A vapor phase deposition process has been developed, using the experimental apparatus shown in Figure 1, to form the heavily doped n-region. A melt-grown p-type GaSb substrate is placed in the deposition zone; HCl is introduced over the gallium boat to transport the gallium (predominately a subchloride) to the reaction zone, where it combines with antimony hydride (SbH_3) and the dopant carrier, hydrogen

Vapor-Deposited, Tellurium-Doped GaSb

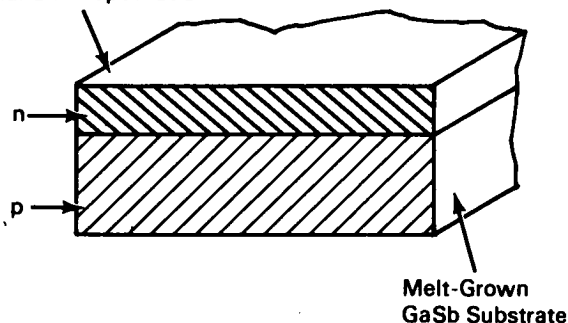


Figure 2. Cross Section of GaSb Device Formed with Vapor Deposited n-Layer

telluride (H_2Te), to form n-type GaSb on the substrate. Since the growth rate of GaSb is quite low, less than 5 microns/hr, and Te has a high diffusion constant, temperatures as low as 400°C are required to prevent out-diffusion of Te into the substrate.

A cross section of a typical n-p structure is shown in Figure 2. Net electron concentrations of $2 \times 10^{17} \text{ e/cm}^3$ in the n-region have been obtained. Fundamental factors which limit the growth of GaSb from the vapor phase are the low melting point of GaSb (712°C) and the low vapor pressure of antimony (1 mm).

Notes:

1. Further development of the vapor deposition would enable Gunn diodes, electroluminescent devices and transistors to be fabricated from high quality GaSb.

(continued overleaf)

2. Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
Reference: B70-10500

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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